

A Comparative Study on the Competitiveness of China's High Technology Enterprises of Different Regions

Yonghua Zhu

School of Economics and management, Wuhan Institute of Technology

Wuhan 430070, China

E-mail: daliao7017@163.com

Abstract

Based on the data from China's high technology statistics, this paper compares the competitiveness of high technology enterprises of three different regions in China from the three angles for judging the competitiveness of enterprises, respectively, the indicator values of the competitiveness of sizes of enterprises, the indicator values of the competitiveness of management of enterprises, and the indicator values of the competitiveness of innovation of enterprises, analyzes the reasons from the perspective of regional economic development, enterprise innovation strategies, and human resources, and put forwards measures to buildup the competitiveness of high technology enterprises in China, which are to implement the strategy of utilizing knowledge to create fortune, to enhance the cooperation among industry, academia and research, to improve policies and regulations, and to set up service system supporting the growth of high technology enterprises.

Keywords: High technology enterprises, Competitiveness of enterprises, Regional comparison

1. The comparison of the competitiveness of high technology enterprises of three main regions in China

The tractive function of high technology industries in regional economic innovation capacity is increasingly prominent. By comparing the differences of the holistic competitiveness of high technology enterprises in various regions, the reasons for the generation of the differences will be found out and measures will be taken to improve deficiency so as to raise the competitiveness of high technology enterprises in each region. Based on the data from *China Statistics Yearbook on High Technology Industry (2006)* and from the three angles for judging the competitiveness of enterprises, namely, the competitiveness of sizes of enterprises, the competitiveness of management of enterprises, and the competitiveness of innovation of enterprises, the competitiveness of high technology enterprises in three regions, eastern region, middle region and western region, is compared. Please refer to Table One to see the static comparison result of data of the three regions of 2005.

Explanation for the computation of the indicators:

(1) The division of eastern region, middle region and western region: eastern region consists of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Guangxi and Hainan; middle region consists of Shanxi, Inner Mongolia, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan; western region consists of Chongqing, Sichuan, Guizhou, Yunnan, Xizang, Shanxi, Gansu, Qinghai, Ningxia and Xinjiang. (State Statistical Bureau, 2006)

(2) The computation formula for the second class indicators:

The average gross output of enterprise = the gross output of enterprises of the year / the number of enterprises of the year

The average value added of enterprise = the gross value added of enterprises of the year / the number of enterprises of the year

Sales profit rate = the gross profits of enterprises of the year / the gross sales income of the enterprises of the year

The velocity of fixed assets = the gross sales incomes of enterprises of the year / the average net value of fixed assets of the year

Value added rate = value added of enterprises of the year / the gross output of enterprises of the year

The input intensity of R&D capital = the gross inner expenditure on R&D of enterprises of the year / the gross sales incomes of enterprises of the year

The input intensity of R&D personnel = the converted equivalent time of full time work of R&D personnel of the year / the total number of enterprises of the year

The input intensity of technology introduction = (the expenditure of enterprises on introducing technologies +

expenditure of enterprises on technology transformation + expenditure of enterprises on digesting and attracting technology + expenditure of enterprises on purchasing technology) of the year/the total number of enterprises of the year

The patent application rate=the total number of enterprises who apply for patents of the year/the total number of enterprises of the year

The expenditure rate of new product development=gross expenditure on developing new products of enterprises of the year/the gross sales incomes of enterprises of the year

The expenditure input rate of enterprise on science and technology activities=the total sum of capital of enterprises in the expenditure raised on science and technology by enterprises of the year/expenditure raised on science and technology by enterprises of the year

The output of new products=the gross output of new products of enterprises of the year/the total number of enterprises of the year

The sales rate of new products=the gross incomes of new products of the year/the gross sales incomes of the enterprises of the year

The patent holding rate=the total number of patents created and held by enterprises of the year/the total number of enterprises of the year

The comparison result shows that: in 2005, with regard to the competitiveness of the sizes of high technology enterprises, the eastern region evidently kept ahead of middle region and western region in enterprise number, gross output and value added; among the three second-class indicators of the competitiveness of management of high technology enterprises, except that the velocity of fixed assets of the eastern region kept ahead, the three regions did not vary a lot in sales profit rate and value added rate; as for the innovation capacity of enterprises, the capacity of innovation input of the western region kept ahead of the eastern region and the western region; the eastern region kept ahead of middle region and western region in the capacity of innovation implementation and the capacity of innovation output.

1.1 The competitiveness of the sizes of enterprises

In 2005, the number of high technology enterprises in eastern region was 13721, accounting for 78.3% of the whole nation, and the average annual output per enterprise was 224 million Yuan; the number of high technology enterprises in middle region was 2321, accounting for 13.2 % of the whole nation, and the average annual output per enterprise was 90 million Yuan, for which the eastern region was 2.5 times of the middle region; the number of high technology enterprises in the western region was 1485, accounting for 8.5 % of the whole nation, and the average annual output per enterprise was 102 million Yuan, for which the eastern region was 2.2 times of the western region; Seen from the total number of enterprises and the average annual output per enterprise, the competitiveness of high technology enterprises in eastern regions kept far ahead of that in the middle and western regions.

1.2 The competitiveness of the management of enterprises

The sales profit rate of the eastern region was 4.1%, the middle region 5.3%, and the western region 4.3%, in which the middle region was better than the western and eastern region. The velocity of fixed assets of the eastern region was 4.87 times/per year, the middle region 2.31 times/per year, the western region 1.96 times/per year, in which the eastern region was evidently faster than the middle and western region, and the eastern region was respectively 2.1 times and 2.48 times of the middle region and western region. The value added rates of the eastern, middle and western region were respectively 22.5%, 33.1% and 33.2%, in which the western and middle region were higher than the eastern region.

Analyzing from the three second-class indicators of the competitiveness of management of enterprises, except that the velocity of fixed assets of the eastern region was evidently faster than that of the middle and western regions, the high technology enterprises in middle and western region was better than that in the eastern region in the other two indicators. Analyzed from the three indicators of the competitiveness of management of enterprises as a whole, the high technology enterprises in eastern, middle and western regions varied little in this aspect.

1.3 The competitiveness of the innovation of enterprises

1.3.1 The technology innovation input of enterprises

The competitiveness of high technology enterprises is mainly determined by whether this enterprise possesses technology resources of high level, human resources who are of high intelligence and innovation capacity, and solid capital source. (Huang, 2002) The innovation capacity of enterprises is determined by the enterprises' input in innovation. Under the same condition, the more the enterprise inputs in technology innovation, the more the output

may be. The technology innovation capacity includes the capital input intensity in R&D, the input intensity in R&D personnel and the expenditure input intensity on technology introduction, etc. With regard to the capital input intensity in R&D, the western region was 2.1%, middle region 1.3%, and eastern region 1%, in which the western region was evidently higher than the eastern and middle regions. The capital input intensity in R&D of Shanxi and Sichuan respectively accounted for 41.3% and 38% of the gross input of the western region and the summation of Shanxi and Sichuan accounted for 79.3% of the gross input of the western region in 2005. As a result, the input of Shanxi and Sichuan was in leading position in the western region and the capital inputs in R&D in provinces in the western region were severely imbalanced.

The input intensity of R&D personnel in eastern, middle, and western regions were respectively 8.65 persons per year per enterprise, 12.62 persons per year per enterprise, and 17 persons per year per enterprise, in which the western region was almost 2 times of the eastern region. The input of R&D personnel in Shanxi and Sichuan together accounted for 75.6% of that in the western region in 2005. The expenditure input intensity on technology introduction in 2005 in the eastern, middle and western regions were respectively 1.5 million Yuan /enterprise, 1.6 million Yuan/enterprise and 2.3 million Yuan/enterprise, in which the western region was far higher than the average value of enterprises in the middle and eastern regions. The expenditure input on technology introduction in Shanxi, Sichuan and Chongqing altogether accounted for 75% of that in the western region.

To sum up, to analyze from the date of the capacity of innovation input in the three regions, high technology enterprises in the western region were evidently higher than those in the middle and eastern regions in the input intensity of R&D capital, R&D personnel and the expenditure on technology introduction, but the input levels of the provinces in the western region were severely imbalanced. The input in the western regions concentrated in Shanxi, Sichuan and Chongqing.

1.3.2 The capacity of innovation implementation of enterprises

The capacity of innovation implementation of enterprises is the capacity of enterprises under the premise of guaranteeing innovation input, to transform the innovation assumption into design principles, new products and production prototypes, including research and development capacity and production capacity, etc. (Ge, 2005) , whose specific indicators include patent application rate, expenditure rate of new product development, expenditure input rate of enterprises on science and technology activities, and the bringing into production rate of completed projects. The patent application rates of the eastern, middle and western regions were respectively 1.06 item/enterprise, 0.5 item/enterprise and 0.73 item/enterprise, the number of which in the eastern region was more than that in the middle and western regions. Considering that the total number of enterprises in the eastern region accounted for 78.3% of the whole nation, the absolute amount of patent application by enterprises in the eastern region was far higher than that by enterprises in the middle and western regions. The expenditure rates on new products development in the eastern, middle and western regions were respectively 1.2%, 1.5% and 2.2%, in which the western region was evidently higher than the middle and eastern regions, while the expenditure on new products in Shanxi and Sichuan altogether accounted for 75.2% of that in the western region.

The expenditure input rate of enterprises on science and technology activities demonstrates the positions and functions of enterprises in science and technology activities. In developed countries in the west, the main body of technology innovation is enterprise and in expenditure input and use, enterprises occupy absolute superiority. This indicator can examine and check the marketization of innovation of enterprises. In 2005, the expenditure input rates of enterprises on science and technology activities in eastern, middle and western regions were respectively 89.6%, 77.5% and 62.4%, which decreased in turn and among which the eastern region was the highest, 17.2% higher than that in the western region. This shows that the high technology enterprises in the eastern region implement knowledge innovation production mode which can directly create fortune, centering on the creation of patents (the absolute amount and comparative indicators of patent application in the eastern region were far higher than that of high technology enterprises in the middle and western regions). The mode in the eastern region is evidently different from those of the middle and western regions who implement knowledge innovation modes which pursues the leading international level centering on the creation of thesis papers internationally embodied. (Zhao, 2005) The bringing into production rate of completed projects incarnates the level of enterprises in the capacity of innovating production. In 2005, the bringing into production rates of completed projects in the eastern, middle and western regions were respectively 45.91%, 45.43% and 37.56%, which shows that eastern region and western region were equal in the capacity of innovation implementation and were both higher than that of high technology enterprises in the western region.

To sum up, in the indicator of the capacity of innovation implementation, except that the western region kept ahead in expenditure input rate of new product development (but imbalanced within the region), the eastern region evidently kept ahead of the western region and the middle region in patent application rate, expenditure input rate of

enterprises on science and technology activities and the bring into production rate of completed projects. What is more, through comparison and analysis, we can find that the eastern region implements knowledge innovation production mode which can directly create fortune, centering on the creation of patents, which is evidently different from those of the middle and western regions who implement knowledge innovation modes which pursue the leading international level centering on the creation of thesis papers internationally embodied.

1.3.3 The capacity of innovation output of enterprises

The capacity of innovation output of enterprises refers to the capacity of enterprises to innovate technology so as to decrease costs, create markets and generate incomes and reflects the economic profits and technology advancement brought by the technology innovation.(Ge,2005) It mainly includes the income capacity of new products, the sales capacity of new products, and the market occupying capacity of new products and the specific indicator include the output of new products, sales rate of new products and patent holding rate. The capacity of innovation output is the significant indicator to weigh the capacity of enterprises to create fortune and contribute to society. The innovation capacity of enterprises incarnates itself through the capacity of innovation input and the capacity of innovation implementation and ultimately through the capacity of innovation input. (Yang, 2007) In 2005, the outputs of new products in eastern, middle and western regions were respectively 46 million Yuan/enterprise, 20 million Yuan/enterprise and 30 million Yuan/enterprise. The average output of new products of high technology enterprise in the eastern region was 2.3 times of that of the middle region and 1.53 times of that in the western region. The differences among the three regions were large. The sale rates of new product in 2005 in the eastern, middle and western regions were respectively 20.4%, 13.8% and 30.2%, for which the western region was the highest, the eastern region in the middle position and the middle region the lowest. However, the incomes of sales of new products of Sichuan in the western region accounted for 53.2% of that in the western region and accounted for 78% of the western region together with that of Shanxi. It can be evidently seen that the sales of new products of high technology enterprises mainly concentrate in Sichuan, Shanxi and Chongqing. The patent holding rates of the eastern, middle and western regions were respectively 0.42 item/enterprise, 0.2 item/enterprise and 0.31item/enterprise. Through analysis, it can be found out that the patent holding rates in the eastern, middle and western regions is highly related to the output of new products.

In conclusion, judging from the capacity of innovation output of enterprises, the high technology enterprises in the eastern region were far higher than those in the middle region and western region in the output of new products and patent holding rate, which reflected that the capacities of high technology enterprises in the eastern region in exploring market, creating technology and innovating economic profits were far better than those in the middle region and the western region.

The result of the comparison of the competitiveness of high technology enterprises in the three regions from the 16 indicators of the 3 dimensionalities makes clear that the high technology enterprises in the eastern region were evidently higher than those in the middle region and western region in the competitiveness of the sizes of enterprises and the competitiveness of innovation of enterprises, while the competitiveness of management of enterprises of the three regions varied little. Considering that the innovation capacity of high technology enterprises is the key and core indicator of capacity, the comparatively high innovation capacity of high technology enterprises in the eastern region forms the superiority of the competitiveness of sizes. In the comparison of the three regions, the middle region, except that it was almost equal with the eastern region and western region in the competitiveness of the management of enterprises, fell behind the eastern region and western region in the competitiveness of sizes and the competitiveness of innovation capacity, so the middle region is of the weakest position in the development of high technology enterprises and measures shall be taken in order to keep up with the other two regions.

2. Analysis on the reasons of the differences of competitiveness of high technology enterprises in the three regions

The main reasons for the formation of the differences of competitiveness of high technology enterprises in the three regions are:

2.1 The differences of regional economic development influences the competitiveness of enterprises

From the economic development condition of China, the eastern region possesses comparatively advanced technology and abundant capital basis, while the middle region and the western region are weak in these two aspects, for which China implemented imbalanced development strategy of regional economy which gradually developed economy from the east to the west in 1980s and 1990s. Under the instruction of this strategy, China implemented many preferential policies for regional development to the eastern region, resulting that the economy growth speed in the eastern region gradually exceeded that in the middle and western regions. Attracted by better incomes, more opportunities to find jobs, and capital profit, human resources and capital flowed to the west in large amount. As a

result, the economy center of gravity moved towards the east and the high technology enterprises in the eastern region rapidly grew up and developed fast. The fast economic development laid a solid material foundation for the eastern region to carry out technology innovation, provided the eastern region with the capacity to bring into, explore and utilize persons with ability, technology and key equipments to carry out technology innovation, and further enlarged the distance of the eastern region with the middle and western regions.

2.2 From the persons with ability and the key resource that determines the competitiveness of high technology enterprises, there exists certain gap in the storage amount of human resources in the three regions no matter judging from the comparative sizes of education or from professional technicians. Persons with ability are the core in technology innovation activities and the discovery. To grasp innovation chances needs piloting persons with ability and of high makings; the research and development activities need technicians of high makings; the transformation of development fruits need personnel of high makings; successful market exploration needs marketing persons with ability and of high makings; the organization, administration and assisting of innovation activities need piloting persons with ability and management persons with ability and of high makings. The reform of science and technology system in the eastern region is deeper compared with that in the middle region and western region and the prospective of science and technology policies is comparatively stronger. Most of the enterprises in the eastern region can provide loose environment for workers to innovate, can select talents of innovation type and put them in important positions, can share innovation fruits with the innovators, and adopt flexible person using systems; at the same time, inside the enterprises, there forms an open culture atmosphere for innovation which enhances the cohesion power of enterprises towards their workers and the attraction power of enterprises to the outside; these reasons altogether lead persons with high technology levels and administration talents of high makings to continually flow from the middle and western regions to the eastern region, which has accumulated solid human resources for the eastern region to innovate technology and led the middle region and western region go short of innovation talents. Persons with ability are the key for enterprises to realize technology innovation. The lack of persons with ability, particularly the lack of persons with high technology, is the main reason for the deficiency of innovation capacity and weakness of competitiveness of enterprises in the middle and western regions.

2.3 The influence of knowledge development strategy

There are two kinds of knowledge production modes. One is to pursue the leading international level centering on the creation of thesis papers internationally embodied. The other is to directly create fortune, centering on the creation of patents. Whether a region uses its knowledge recourse in knowledge production to pursue the leading international level or to directly create fortune exerts direct influence on the its technology innovation and the industrialization of high technology and further influences its economic growth speed. The direction of the latter knowledge production pays more attention to the marker value of knowledge and through technology innovation; this mode can directly transform knowledge production into market profits for enterprises. The huge superiority of the eastern region in patents is just the result of this kind of knowledge resource collocation. Although there are many science and resource institutes and higher education colleges in the western region (such as Shanxi, Chongqing, Sichuan and Gansu), there lacks cooperation among enterprises. The western region adopts the knowledge production mode which pursues the leading international level, which directly influences the industrialization level of its high technology. The differences of knowledge development strategies lead into such situation that the eastern region is evidently higher than the middle and western regions in the innovation output of high technology enterprises.

3. The countermeasures for raising the competitiveness and innovation ability of high technology enterprises in China

In order to realize the sustainable development strategy, the competitiveness of high technology enterprises in China, especially their innovation capacities, must be raised. The corresponding countermeasures that can be adopted are mainly as follows.

We should implement “directly create fortune” knowledge strategy, urge enterprises to quickly face the markets and to become the innovation main body in exploring markets and pursuing fortune. The details include: first, we should make enterprises the main body of research and development. The innovation and development jobs are mainly carried out in enterprises, so we should encourage and support the qualified high technology enterprises to set up and improve their technology researches and development centers, closely combine industry, academia and research projects with technology centers, reform the existing science and technology system, push enterprises to construct research and development institutes together with science and research institutes, encourage enterprises to cooperate with science and research institutes in multi-channels to participate in science and technology fruits transformation and the industrialization of high technology. Second, we should make enterprises the investment main body in innovation, and establish innovation investment and financing mechanism and system of multi-channels with

enterprises as the investment main body. Third, we should make enterprises the distribution main body in the innovation profits and grant enterprises the right to freely distribute their innovation profits.

The cooperated innovation among industry, academia and research shall be enhanced. Enterprises shall together with high schools and science and research institutes carry out technology transfer, cooperate in research, cooperate in development, entrust in development and construct new enterprises. A new type of cooperation mechanism based on industry, academia and research, supported by enterprises and piloted by government shall be constructed. We should scientifically apply the piloting function of government actions and centralize necessary policies, capitals and persons with ability for the cooperation of industry, academia, and research and provide conditions macroscopically. With regard to cooperation distribution mechanism, we should quicken enterprises to participate in research and development, shoulder expenditure on research and development, and what is more important, we should let the research and development notice the need of industrialization so as to avoid mistakes.

The government shall establish and improve innovation policies and regulation system, enhance the macroscopical piloting and monitoring by the state and accelerate the establishment of technology innovation system and operation mechanism for it. At present, the policies, regulations and various measures for technology innovation in China are imperfect. Therefore, the government can start from doing researches on the actual conditions, problems and obstacles in the innovation encountered by high technology enterprises and then formulates and perfects relevant policies and regulations. In addition, the government shall formulate long-term plans and centralize certain amount of capital to overcome difficulties in innovation and to be applied to key technology of great significance. The government shall further enhance propaganda so as to raise the innovation consciousness of the whole society, plan the innovation system of high technology of the whole nation, push the cooperation among industry, academia, and research, and pilot in the cooperation among enterprises, make use of policies of exemption from tax in tax and equipment renovation, encourage enterprises to invest themselves, set up risk investment funds and encourage the industrialization of high technology.

We shall improve the socialized service system for the growth of high technology enterprises. Through providing high technology enterprises with consulting, information and training, the socialized service system can push the high technology enterprises to carry out innovation activities and drive enterprises to grow. This is a successful experience from the industrialized countries. Since the opening up and reform of China, Chinese government has done many jobs on providing high technology enterprises with consulting, information and training services, but there are still many problems to be solved, such as the lack of general planning, imperfectness of service system, insufficiency of support intensity. Henceforth, governments of various levels shall enlarge their support intensity and further improve the service system for the growth of high technology enterprises.

This paper is one of the research achievements of the projects subsidized by the open-type funds "Hubei Research Center for the Enterprises Competitiveness", the key base for humanities and social science of Hubei province.

References

- Ge, Xinquan, Li Jingwen & Peng, Juanjuan. (2005). *Technology Innovation and Administration*. Beijing: Social Science Literature Press.
- Huang, Benxiao, etc. (2002). *Science and Technology Advancement and Regional Economy*. Wuhan: Wuhan University Press.
- State Statistical Bureau, National Development and Reform Commission and Ministry of Science and Technology. (2006). *China Statistics Yearbook on High Technology Industry*. Beijing: China Statistics Press.
- Yang, Shuwang & Zhu Yonghua. (2007). The demonstration research on the relationship between the appraisal indicators for input capacity and output capacity in the appraising of the innovation capacity of enterprises. In *Statistical Research*. 2007 (8).
- Zhao, Yuming & Zhao, Zengyao. (2005). A regional comparison of the technology innovation capacity of high technology enterprises in China and analysis on the reasons. In *Human Science Journal*. 2005 (6), pp.67-71.

Table 1. Table for the General Comparison of the Competitiveness of High Technology Enterprises in Eastern, Middle, and Western China of 2005

First Class Indicators	Second Class Indicators		Eastern Region	Middle Region	Western Region	National Average
The Competitiveness of Size of Enterprises	The number of enterprises: number/%		13721/78.3	2321/13.2	1485/8.5	17527
	Average Gross Output: 100 million Yuan / enterprise		2.24	0.9	1.02	1.96
	Average Value Added: 100 million Yuan/ enterprise		0.51	0.3	0.34	0.46
The Competitiveness of Management of Enterprises	Sales Profit Rate: %		4.1	5.3	4.3	4.2
	Velocity of Fixed Assets: times/year		4.87	2.31	1.96	4.34
	Value added rate: %		22.5	33.1	33.2	23.6
The Innovation Capacity of Enterprises	The Capacity of Innovation Input	The Input Intensity of R&D Capital: %	1	1.3	2.1	1.1
		The Input Intensity of R&D Personnel: person per year/enterprise	8.65	12.62	17	9.88
		The Input Intensity of Technology Introduction: 100 million Yuan/enterprise	0.015	0.016	0.023	0.016
	The Capacity of Innovation Implementation	Patent Application Rate: item/ enterprise	1.06	0.5	0.73	0.96
		Expenditure Rate of New Product Development: %	1.2	1.5	2.2	1.2
		The Expenditure Input Rate of Enterprises on Science and Technology Activities: %	89.6	77.5	62.4	86.4
		The Bringing into Production Rate of Completed Projects: %	45.91	45.43	37.56	44.51
	The Capacity of Innovation Output	The Output of New Products: 100million Yuan/enterprise	0.46	0.2	0.3	0.4
		The Sales Rate of New Products: %	20.4	13.8	30.2	20.4
		The Patent Holding Rate: item/enterprise	0.42	0.2	0.31	0.38

Source: *China Statistics Yearbook on High Technology Industry* (20060, edited by State Statistical Bureau, National Development and Reform Commission and Ministry of Science and Technology, published by China Statistics Press in September 2006 in Beijing.)